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The impacts of Humanitarian Assistance/Disaster Relief operations on the mental health of Marines

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THESIS

THE IMPACTS OF HUMANITARIAN ASSISTANCE/ DISASTER RELIEF OPERATIONS ON THE MENTAL HEALTH OF MARINES

by

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December 2015

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THE IMPACTS OF HUMANITARIAN ASSISTANCE/ DISASTER RELIEF OPERATIONS ON THE MENTAL HEALTH OF MARINES

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LIST OF ACRONYMS AND ABBREVIATIONS

AFQT	Armed Forces Qualification Test
ASVAB	Armed Services Vocational Aptitude Battery
CAPER	Comprehensive Ambulatory/ Professional Encounter Record
CTS	Contingent Tracking System
CY	Calendar Year
DMDC	Defense Manpower Data Center
DOD	Department of Defense
DSM	Diagnostic and Statistics Manual
EDIPI	Electronic Database Interchange Personal Identification
HA/DR	Humanitarian Assistance/ Disaster Relief
HR	Hazard Ratio
HSM	Humanitarian Service Medal
ICD	International Classification of Diseases
MCTFS	Marine Corps Total Forces System
MOS	Military Occupational Specialty
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
PTSD	Post-traumatic Stress Disorder
SADR	Standard Ambulatory Data Record
SIDR	Standard Inpatient Data Record
TEDI	Tricare Encounter Data- Institutional
TEDN	Tricare Encounter Data- Non-institutional
TFDW	Total Forces Data Warehouse
TMA	Tricare Management Activity
VA	Veterans Affairs

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I. INTRODUCTION

A. BACKGROUND

Following the attacks on September 11, 2001, the United States military entered its longest period of continuous armed conflict since the Vietnam War. From the point when the United States entered Afghanistan in October 2001 and Iraq in 2003, more than 1.6 million service members deployed to at least one of the two theaters of combat (Seal, 2009). As the United States military fought through a new generation of warfare, often involving an unknown enemy, hostile local populations, improvised explosive devices and high rates of collateral damage, a new form of casualty became prevalent.

Multiple, consecutive combat deployments in support of Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) have resulted in a significant increase in the rate of mental-health casualties throughout the military. In an effort to better understand, treat, and prevent these injuries, the Department of Defense (DOD) commissioned several studies tailored to combat veterans. These studies, as well as the ever-increasing public awareness surrounding appropriate medical care of veterans, have led to increased cognizance on mental health issues faced by service members.

As situational awareness grew around the negative effects the Global War on Terrorism had on mental health of service members, so did questions regarding the impacts on mental health of other forms of military operations. Humanitarian Assistance/ Disaster Relief (HA/DR) operations, for example, have been a large part of the Marine Corps' mission for the last several decades. Since 1975, the DOD has participated in over 300 named Humanitarian Assistance operations throughout the country and around the world (DOD, 2012). Between 2001 and 2011, the same time period both OIF and OEF were at their height, the Marine Corps responded to 44 separate HA/DR operations with over 30,000 service members participating.

The primary mission of the U.S. military is to provide national defense and to protect national interests abroad. An argument has been made that a military force, particularly the U.S. military is, "an inappropriate provider for humanitarian aid and that

HA/DR operations negatively impact the military's warfighting mission" (Spring, 1993). Also, a belief that the military is not trained or equipped—and should not be trained or equipped—for providing humanitarian aid exists to deter military use in this capacity. Further, the use of a third-party military can oftentimes escalate an already tragic and deadly situation into an armed conflict, as evinced during Operation Restore Hope in Somalia (Stockton, 1997). However, the number of HA/DR operations to which the U.S. military has responded is increasing, with the DOD responding to more HA/DR operations in 2011 than in any year since 1999 (DOD, 2012).

Ultimately, several reasons explain why the military is used, and will continue to be used, to conduct HA/DR operations instead of nonmilitary agencies such as the United States' USAID. As Ritchie and Mott (2003) said, "These agencies may not be structured to handle massive humanitarian requirements without military assistance. Few organizations outside of the military have the capacity to quickly move materiel, establish secure routes for aid delivery, develop command and control mechanisms, and provide direct assistance." Although the physical architecture provided by a military when conducting a HA/DR operation is of undeniable value, there often exists a political ulterior motive in governments' deploying relief troops. "The deployment of military forces to assist with a foreign emergency is a very visible show of support for a foreign government and its people" (Ritchie & Mott, 2003). In theory, a population given come form of humanitarian assistance by U.S. military units will be more likely to support a U.S. military presence in the future, therefore furthering U.S. national interests abroad.

B. RESEARCH QUESTIONS

Regardless of the reason or motivation behind military involvement in them, HA/DR operations are a type of mission that Marines will continue to execute in the future. As a result, there may exist a risk for long-lasting detrimental mental health effects related to participation in HA/DR operations. This thesis seeks to determine whether participation in a Humanitarian Assistance/ Disaster relief operation correlates with an increase in the diagnosis of mental health diagnosis rates among Marines. Further, because this research is being conducted following 14 years of continuous

combat operations, this thesis will determine whether the HA/DR participation effect, if any, differs when a Marine has also completed a combat deployment. Finally, the HA/DR participation effect will be evaluated to determine if its prevalence is different between ranks, genders or military occupational specialties (MOS).

C. ORGANIZATION

The remainder of this thesis consists of four chapters to support analysis of the research questions. Chapter II focuses on an overview of Humanitarian Assistance/ Disaster Relief operations and the Marine Corps' role in HA/DR response. A review of existing relevant literature on the mental-health effects military deployments, regardless of type, have on military members is presented along with studies of civilian relief workers and emergency first responders. Finally, the first chapter include a brief overview of the mental illnesses used in the study so to provide an understanding of how HA/DR participation can result in mental illness.

Chapter III of this thesis concentrates on the data and methodology used for analysis. Data obtained from the Tricare Management Activity (TMA), the Defense Manpower Data Center (DMDC) as well as the Marine Corps' Total Forces Data Warehouse (TFDW) are refined and constructed into an analytical working file that allows for analysis in support of answering the research questions. The analysis involves a combination of descriptive statistics and multivariate regression models, which are described in detail in this section.

The final portion of this thesis involves the last two chapters: Results and Conclusions. Here, a detailed analysis of the multivariate regression results, as well as the overall study's implications, are discussed. Understanding what effect, if any, participation in a HA/DR operation has on a Marine's mental-health will provide military leaders and mental health professionals invaluable insight to allow for proper pre and post deployment screening, evaluation and treatment. Ultimately, the hope is that this thesis provides information to military leaders so that the risk to a Marine's mental-health following a HA/DR operation is as mitigated as possible.

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II. LITERATURE REVIEW

A. INTRODUCTION

Very few studies have been conducted that focus on the mental health of service members following a HA/DR operation. As a result, a collection of literature that concentrates on civilian relief workers and first responders will be presented. These two groups of workers have several commonalities with military HA/DR personnel that lead to a better understanding of what a Marine responding to a HA/DR operation may experience.

In addition to presenting information on relief workers and first responders, this chapter will also examine mental health impacts of military deployments in general—without focus on combat or humanitarian assistance operations. For service members, simply leaving a well evolved support structure of friends and family to travel to foreign lands for extended periods of time presents opportunities for mental health problems.

B. PAST RESEARCH ON RELIEF WORKERS

"Humanitarian relief workers are at a higher risk for developing trauma related mental illness due to their ongoing exposure to primary and secondary trauma" (Holloway & Everly, 2010). "Specifically, intensity and duration of exposure have been shown to play an important role in symptom development" (Norris, Friedman, Watson, Byrne, & Diaz, 2002). Workers are subjected to complex emergencies and disasters where death and destruction often runs rampant. Stress and mental fatigue surrounding exposure to these types of environment are amplified by separation from "normal sources of psychological and social support" (Connorton, Perry, Hemenway, & Miller, 2011). Work associated with disaster relief is unpredictable and often puts the relief worker in danger at times. A 2000 study of death among humanitarian aid workers found that, "of 375 known deaths, 69% were due to violence" (Connorton et al., 2011). These traumatic events leave humanitarian aid workers at risk for both acute and chronic post-traumatic stress, depression and anxiety.

There exists no question that the work conducted by humanitarian assistance workers is stressful, exhausting and, at times, dangerous. The level of strain placed on relief workers is substantial, with mental health effects similar to those experienced by combat veterans: edginess, hypervigilance, aggression, withdrawal, sleep disturbances and more (Holloway & Everly, 2010). Although these effects are applicable to the many flavors of relief workers (non-governmental organizations, United Nations, military) opinions on the impacts of a HA/DR operation on military units in particular seem to vary.

In the conduct of a meta-analysis performed by Connorton et al., researchers reached the conclusion that organized military units are less affected by the stresses and danger prevalent in humanitarian assistance operations. The claim includes that, because military units responding to a humanitarian assistance operation deploy from abroad as a highly cohesive workforce they are better prepared and equipped for the trials of disaster relief. Further, the researchers suggest that because military relief workers are armed, the threat of personal injury is lessened and therefore so is the potential to develop a trauma related illness. Finally, the suggestion that pre-deployment and post-deployment medical screening measures in place are an effective tool in combating trauma related mental illness (either PTSD, depression, anxiety disorders and substance abuse) and set the military apart from non-military relief workers. Although all of these claims are based on observations and seem to hold a high level of validity, they are not viewed as unanimously accurate.

Conversely to the views just discussed that put military humanitarian workers at a lower risk for developing trauma related mental illness, Holloway and Everly's (2010) approach to the mental impact of HA/DR operations argues the risk is just as high or higher than non-military relief workers. HA/DR missions pose a unique set of challenges to military units that do not necessarily exist in combat. For example, in combat a Marine's main focus is on surviving and, as a result, the majority of a Marine's thoughts are on surviving. Holloway and Everly present that, without taking away from the stress inherent to combat operations, the lack of concern for survivability in a HA/DR operation allows for more introspective and potentially harmful thoughts. In responding to a

HA/DR operation, Marines are usually thrust into an environment in which they know little about the culture, history, language, or needs of the local population. The frustration that surrounds an inability to understand what is truly needed in an emergency situation, and then not being able to provide for that need, has the ability to cause significant harm to a Marine's self-confidence and self-efficacy. "Even when they are able to make small positive impacts on a local community (when conducting a HA/DR operation) they may later become disillusioned when they realize the futility of their efforts if the mission took place in an area lacking the proper infrastructure to continue provision of services after they depart" (Ritchie & Mott, 2003). Similar feelings have been felt by veterans of Operation Iraqi Freedom following the recent fall of key cities such as Ramadi and Mosul to the Islamic State (NPR Staff, 2014).

C. PAST RESEARCH ON FIRST RESPONDERS

Exploring past research of the impacts combat has on military service members provides some benefit to this thesis. The studies serve to provide a background for what service members may or may not be exposed to prior to a HA/DR operation, they give a glimpse into the culture of the military and also provide detailed summary statistics for comparison. However, there exists a significant difference experienced in combat and in a HA/DR operation. In combat, the trauma experienced is often focused on the individual and his survival or the survival of his closest friends. This level of threat to personal safety may not exist in a HA/DR operation. However, there is an exposure to death and destruction of an innocent population. As one Marine said, "It's one thing to see a dead body in combat. It's another thing to see dead bodies being pulled from rubble" (Talton, 2010).

Because of a lack of research available into the mental health effects of a humanitarian operation, we will turn to a substantial base of knowledge on the mental health impacts faced by first responders. For both of these studies, "first responders" refers to police, firefighters, paramedics, and search and rescue personnel.

Arguably, 9/11 is the most well-known disaster to face this country in the last 50 years. In a time of need, thousands of first responders flocked to the World Trade Center

in New York in an effort to provide assistance. These responders were all part of a police force, the military, or a fire department, each responder with substantial prior training and exposure to traumatic events. These characteristics, similar to those possessed by Marines responding to a HA/DR operation, add validity to the comparison between the two.

In this study, the researchers used a combination of semi-structured interviews and standardized self-report measures to assess rates and severity of PTSD and other diagnosable mental disorders four and six years after the September 11 attacks.

Cukor et al. (2011) state, "Studies have found high rates of PTSD, major depressive disorder, and substance abuse or dependence, with PTSD believed to be the most common mental health problem following disaster." Further, there was a significant difference in diagnosis of "full PTSD" and "partial PTSD," which were related to two main factors (Cukor et al., 2011).

The first factor was the presence of depression soon after the disaster. This is significant because, as discussed earlier, depression can be diagnosed after two months of continuous symptoms or, in rare occurrences, after a single incident. The shortened timeframe needed for diagnosis, the continued work in law enforcement or fire rescue following 9/11 and the fact that Cukor et al.'s first period for interviews was four years after 9/11 again show the potential for comorbidity between the two disorders.

The second factor differentiating "full PTSD" from "partial PTSD" was either the continuous or greater occupational exposure post disaster. This factor is especially pertinent to Marines as training for combat is continuous, as is the threat of deploying to a combat zone. Also, it is not uncommon for a unit of Marines to deploy once to a HA/DR operation and a second time to combat, especially between 2001 and 2011.

A second study relevant to mental health following a humanitarian assistance or disaster relief operation involved the study of New Zealand police following the Canterbury earthquakes. The Canterbury earthquakes were a series of eight earthquakes and nearly 10,000 aftershocks that rocked New Zealand between September 2010 and January 2012, resulting in 185 deaths and nearly 8,000 injuries. Following the worst earthquake, in February 2011, members of the police force found themselves operating

outside their traditional duties of law and order. “Alongside regular duties, police provided security cordons, organized evacuations and search and rescue, worked in victim identification teams, provided missing persons/family liaison support, and organized media briefings” (Snell, Surgenor, Dorahy, & Hay-Smith, 2014).

The stress caused by these collateral duties was significant and amplified by the level of destruction and sudden onset of earthquakes and aftershocks encountered daily. For Marines, an organization trained and equipped to fight in combat, similar feelings can be expected. In January 2010, Marines responded to the earthquake in Haiti that left over 100,000 people dead. The responding Marines, which consisted of the infantry unit, 1st Battalion, 9th Marines, had been preparing for a combat deployment to Afghanistan when tasked with disaster relief. The rapid change of mission, gear and mindset from one a Marine is prepared for to one that is filled with uncertainty can have lasting impacts on their mental health. As a result, Marines may, “return home being less confident in their own abilities, more frustrated, and haunted by moral and ethical dilemmas than they may have expected from a non-combat mission” (Holloway & Everly, 2010).

This thesis will continue with original research looking into the effects humanitarian assistance and disaster relief operations can have on a Marine’s mental health. We will compare rates of diagnosis of PTSD, depression, substance abuse and suicide among Marines that deployed in support of a HA/DR operation with a sample of Marines that had deployed to combat and a sample of Marines that have not deployed.

D. EFFECTS OF MILITARY DEPLOYMENTS

Although military deployments have been around since the country’s inception, the nature of deployments has evolved in the spectrum of mission sets since the conclusion of World War II. World War II saw the deployment of over 16 million Americans overseas for an unknown period of time to fight a conventional war. The enemy wore uniforms; there was an easily distinguishable front line and service members “were involved for the duration of the war until a wound or other medical or psychiatric condition required their evacuation” (McCarroll, Hoffman, Grieger, & Holloway, 2006). As the 20th century continued and U.S. service-members found themselves in combat

again in Korea and Vietnam, the nature of their deployments differed. Both conflicts were marred by less clearly defined missions and political end-states than World War II and were part of the Cold War's broader campaign against the spread of communism. This campaign brought about the rise of the military's modern continuous global deployment cycle and the expectation for military units to be able to respond to any task ranging from large-scale conventional war to non-kinetic humanitarian assistance operations.

Although the conduct of a military deployment has evolved, the stressors inherent to deploying have remained practically unchanged since first identified during World War II. Newby et al. (2005) outlined what they consider the primary stressors as, uncertainty, separation, isolation, danger, and fatigue. Each of these stressors can be experienced not only in combat but in the conduct of a humanitarian assistance operation as well. When describing the environment faced by HA/DR responders, Holloway and Everly (2010) state they, "must always face the sheer difficulty of operating in environments that are often austere, pose significant language and cultural barriers, may be vulnerable to security threats and lack proper equipment and tools."

Current military deployment cycles focus around five separate phases of deployment: Pre-deployment, Deployment, Re-deployment, Sustainment and Post Deployment (Pincus, House, Christenson, & Adler, 2001). Each stage of deployment differs slightly based on the mission. However, emotional and mental impacts on service members are consistent. For example, the pre-deployment stage of a deployment begins when a service member first learns they will be deploying. This stage can last from weeks to over a year and involves the service member, "balancing a vastly increased workload as well as family preparations, responsibilities, and reactions" (Sheppard & Malatras, 2010).

A major stressor for service members during the pre-deployment phase comes in the form of a constantly changing and evolving mission. Particularly in the last 14 years of combat, it was not uncommon for a unit to be notified for a non-combat deployment only to have its mission change partially through pre-deployment training. The combination of an unknown mission with an unknown deployment duration and

departure date can have, “important implications for the morale and stress level experienced by personnel and their families” (McCarroll, Hoffman, Grieger, & Holloway, 2006). These stressors, though significant, only increase as the service member continues their training and ultimately deploys oversees.

Once deployed, service members are faced with an emotional and physical distance to their normal support structure that makes dealing with stress even more difficult. This separation from friends and family coupled with uncertain deployment length, high work tempo, threat of death or injury and austere living conditions present some of the most significant stressors a service member will ever face (Hosek, Kavanaugh, & Miller, 2006). These stressors are not exclusive to combat deployments and can be found in HA/DR operations as well. According to Holloway and Everly (2010), these stressors as well as the increasing use of the military in HA/DR operations is, “creating an emerging class of humanitarian assistance veterans at a high risk of mental health complications and who have very unique and special needs.”

E. MENTAL HEALTH

Due to the inherant risks associated with military service, as well as the seperation and anxiety associated with deployments, members of the armed forces are at a higher risk for developing mental health problems than those not in uniform (Moore & Barnett, 2013). A service member suffering from a mental disorder can tear at the fabric that is unit effectiveness and readiness, putting more than just their health at risk. Mental health is not only a common struggle for military members, it can also be a debilitating one; a service member’s mental health can extend beyond a personal level to affect overall unit readiness and mission capability (Moore & Barnett, 2013).

This thesis will look at the rates of some of the most common and prevalant mental health disorders found in the military and compare rates of diagnosis among HA/DR responders and those who have not participated in a HA/DR operation. Specifically, this thesis will look at rates of Post-traumatic Stress Disorder (PTSD), depression, substance abuse and suicide. A brief description, diagnostic criteria and relevance to service members will be discussed for each disorder.

1. Post-Traumatic Stress Disorder

An emotional reaction after being exposed to tragedy, trauma or disaster has been prevalent in the world of psychology for hundreds of years. Following the end of the Civil War, soldiers returning home as psychological casualties were diagnosed with "nostalgia" which was considered to be a mild form of "insanity caused by disappointment and longing for home" (Lopez-Ibor, Christadoulou, Maj, Sartorius, & Okasha, 2005). As time passed throughout the 19th and 20th centuries, and war between nations occurred regularly, the knowledge base surrounding traumatic mental illness grew. Although the term used to describe the mental illness varied over time—shell shock during World War I or battle fatigue during World War II—each conflict brought with it a population of distraught, fearful and mentally unstable veterans.

By the end of the Vietnam War, thousands of veterans were being treated at local Veterans Affairs (VA) hospitals as if a diagnosis for "traumatic war neurosis" was available. This common form of treatment occurred nationwide even though no formal diagnosis for a mental illness related to traumatic stress existed (Bloom, 2000). Following intensive research into trauma induced mental disorders, which extended beyond combat into rape, genocide, burn victims and first responders, post-traumatic stress disorder was formalized as a mental health diagnosis and added to the Diagnostics and Statistics Manual of Mental Disorders in 1978 (Bloom, 2000).

A consideration worth noting for post-traumatic stress disorder specifically relevant to military service members is defining exposure to a traumatic event. Exposure can occur in several ways: directly experiencing the trauma, witnessing, in person, the events as they occurred to others or learning that the trauma has occurred to a close friend of family member (American Psychiatric Association, 2013). An additional method of exposure to trauma that is especially significant to humanitarian assistance workers is "Experiencing repeated or extreme exposure to aversive details of the traumatic event(s)" (American Psychiatric Association, 2013). Examples used to support diagnosis with this trauma exposure include, "first responders collecting human remains," an unwelcomed task often performed by relief workers during HA/DR operations. This form of "secondary traumatic stress" mirrors strains placed on therapists and social workers

constantly exposed to, “trauma survivors’ terrifying, horrifying and shocking images; strong chaotic affect; and intrusive traumatic memories” (Jenkins & Baird, 2002). Secondary traumatic stress and its impact on mental health diagnosis has been studied in depth and validated as a powerful trigger for traumatic related mental illness.

A final note on PTSD is that there exists a large population of individuals exposed to trauma who never develop symptoms relating to PTSD. When studying the rate of PTSD among first responders to the September 11 terror attacks on the World Trade Center in New York, Cukor et al. (2011) found that there existed a high percentage of PTSD-free first responders. “The high percentage of workers in this PTSD-free group serves as a reminder of the general resilience of individuals who were called upon to work at a disaster site that do not develop PTSD, and that indeed, PTSD is a disorder that occurs primarily in a subset of individuals who have psychiatric vulnerability combined with more intense exposure” (Cukor et al., 2011).

2. Depression

Depression is one of the most common mental health diagnoses, with over 350 million people diagnosed and suffering from depression worldwide (World Health Organization, 2012). It is the leading cause of disability globally and effects men, women and children. Causes of depression can vary from a loss of job, ending of a relationship or exposure to a traumatic event. Typically, depression is not life threatening; however, if left untreated the illness could progress and result in suicide.

As an illness, depression presents itself in different ways with the severity and duration varying from person to person. The variability in causes, signs, symptoms and severity has led to several disorders categorized under the header of “depressive disorders.” The most common, particularly related to service members returning from humanitarian assistance and disaster relief operations include major depressive disorder and persistent depressive disorder, also known as dysthymia (Holloway & Everly, 2010).

Major depressive disorder can also be diagnosed as a major depressive episode if based on a single incident. “Careful consideration is given to the delineation of normal sadness and grief from a major depressive episode. Bereavement may induce great

suffering, but it does not typically induce an episode of major depressive disorder" (American Psychiatric Association, 2013). Symptoms required for diagnosis of persistent depressive disorder are very similar to those of major depressive disorder with decreased severity but an increased amount of time required for diagnosis (two years.)

One of the biggest concerns with individuals suffering from depression is the threat of comorbidity, or the simultaneous presence of another chronic disease. Research has suggested that those diagnosed with depression are at a higher risk for other disorders, including post-traumatic stress disorder, a variety of adjustment disorders, anxiety disorders and substance abuse (Riddle, Sanders, Jones, & Webb, 2008). For example, a study conducted by Chan et al. found that, "Among veterans with PTSD, rates of comorbid major depression range from 29% to 68%. Among veterans with clinical depression, rates of comorbid PTSD are 36% – 51%" (Chan, Cheadle, Reiber, Unutzer, & Chaney, 2009).

3. Substance Abuse

Substance abuse is a diagnosable mental disorder which features the excessive use of a psychoactive substance "resulting in a combination of cognitive, behavioral and physiological symptoms" (American Psychiatric Association, 2013). Use of the symptom causing substance continues despite significant substance related problems including, "impaired control, social impairment and risk-taking as well as secondary health concerns" (American Psychiatric Association, 2013).

Substance abuse, regardless of type, has historically been a common problem for military members (Jones & Fear, 2011). A study conducted by Shen et al. looked at a series of population-based studies of the U.S. Military between 2001 and 2006 and found that the "incidence of a newly diagnosed substance abuse disorder ranged from 6% to nearly 9%, overall." When looking at the Marine Corps in particular, this number nearly doubles from 5% to 9.3% when the sample is reduced to only Marines who have deployed in support of OIF or OEF (Shen, Arkes, & Williams, 2012). This is significant because the data used for this thesis looks at Marines serving between 2001 and 2011, when the percentage of active duty combat veterans was at its highest.

Although these numbers are significant, they may not accurately reflect the true level of substance abuse within the military. “It is likely that the base rates of heavy alcohol use, particularly among young service members are higher than recorded substance abuse diagnoses” (Mooney et al., 2014). Further, Ramchand et al. (2010) found that, among previously deployed service members, “deployment-related experiences (e.g., combat-related traumas) and psychological distress (e.g., symptoms associated with posttraumatic stress disorder) were associated with frequency of drinking behaviors.”

As with depression, there exists a high level of comorbidity between a diagnosed substance abuse and other mental disorders, such as PTSD. “Both increases in self-reported posttraumatic distress and depressive symptomatology were positively associated with drinking and binge drinking more frequently” (Ramchand et al., 2010).

4. Self-Inflicted Injuries

Service members are subjected to higher levels of stress than a comparison sample of the civilian population. Deployments, life and death decisions, geographical distance from friends and family and a high expectation of performance all contribute a level of stress to a service member unique to the military (Moore & Barnett, 2013). Recently, the statistic that 22 veterans a day commit suicide has become a rallying cry behind the suicide problem faced by men and women in uniform. Though astounding, this number does not represent the current rate among service members and instead represents over 22 million veterans, the majority of whom left active duty decades ago (Zarembo, 2015).

Making a direct comparison to self-inflicted injury rates in the military and self-inflicted rates among the general population presents some unique challenges. For example, the military population consists of a younger average age, is “disproportionately male and has a different composition of race and ethnicity than the civilian population” (Ramchand, Acosta, Burns, Jaycox, & Pernin, 2011). Ramchand et al. (2011) constructed an adjusted national population that mirrored the make-up and demographics of the current military population so to accurately compare self-inflicted injury rates. Using the simulated population for comparison, they found that self-inflicted injury rates in the

simulated comparable population were higher than those in the military. However, military rates were rising while those in the comparable population were remaining constant.

Regardless of the specific rates of suicide, or self-inflicted injuries, within the military, the traumatic work Marines are exposed to when conducting HA/DR operations cannot be dismissed. Further, we have already seen that there exists an increased risk of PTSD, depression and substance abuse diagnosis to relief workers—all of which carry a high degree of comorbidity. Because of this, the threat of a self-inflicted injury as a result of participating in a HA/DR operation must be reviewed and cannot be understated.

F. SUMMARY

Although a base of research does not yet exist into the impacts of Humanitarian Assistance operations on service members, there are similarities with service members effected by combat deployments and first responders effected by natural or man-made disasters. This chapter identified these similarities and how they are related to HA/DR operation participants. Further, a detailed look at the mental health diagnoses most prevalent to these disasters were analyzed. The next chapter will present and describe in detail the data used for this thesis as well as the model constructed to analyze said data.

III. DATA AND METHODOLOGY

A. DATA

Data for this thesis came from three different military sources: Defense Manpower Data Center (DMDC), Tricare, and the Marine Corps Total Forces Data Warehouse (TFDW). The data sources were merged via a scrambled study ID, and provide demographic information, mental health diagnoses and deployment information—including HA/DR participation—for the entire Marine Corps between 2001 and 2011.

1. Defense Manpower Data Center

The Defense Manpower Data Center (DMDC) is a DOD wide data center that serves under the Office of the Secretary of Defense. DMDC responsible for collecting and maintaining an archive of manpower, training, financial and other databases for the Department of Defense. The DMDC database provides two critical data—the master personnel data provide demographic and service characteristics, such as age, rank, marital status and military occupational specialty (MOS). The Contingent Tracking System (CTS) provide limited deployment information for the Marines. In particular, the CTS provides deployment information for those that were deployed under Operation Iraqi Freedom and Operation Enduring freedom (OEF/OIF)). Altogether the data contains 2,687,340 person-year observations on all Marine enlisted personnel and officers who ever served anytime between the first quarter of calendar year (CY) 2001 through the fourth quarter of CY 2011, representing 619,850 unique Marines.

2. Tricare Management Activity Data

TRICARE is the health care system of the Department of Defense provided to active, reserve, retired and military-dependent members of the Armed Forces. Data provided from Tricare Management Activity (TMA) includes all inpatient and outpatient mental health disorder diagnosis that were recorded in both military and civilian health care facilities. For the purposes of this research, mental health diagnosis information

analyzed included post-traumatic stress disorder, depression, substance abuse and self-inflicted injuries, all of which were identified and recorded through Tricare using their appropriate World Health Organization International Classification of Diseases (ICD-9) codes (Medicode, 1996).

The data provided by TMA comes from several different Tricare internal databases that fully capture every aspect of a Marine's inpatient and outpatient treatment history. Two databases, the Standard Inpatient Data Record (SIDR) and the Tricare Encounter Data-Institutional (TEDI) provide information on Marines inpatient treatment, either at a military treatment facility, such as a base hospital or military physician, or a non-military treatment facility such as a local hospital emergency room. Two other databases, the Standard Ambulatory Data Record (SADR)/Comprehensive Ambulatory/Professional Encounter Record (CAPER), and Tricare Encounter Data—Non-Institutional (TEDN) are used in a similar fashion as SIDR and TEDI, but capture outpatient treatment history. When merged, these databases provide a complete snapshot of any individual Marine's medical history, to include mental health.

3. Total Forces Data Warehouse

The Marine Corps' Total Forces Data Warehouse (TFDW) is a database containing information on numerous data fields for all uniformed Marine Corps personnel. TFDW provides leaders with historical financial, demographic and service information on all Marines so to better aid decision making and ensure the well-being of Marines. TFDW collects data from the Marine Corps Total Force System (MCTFS), the central collection point for all data within the operating forces of the Marine Corps. Whereas MCTFS is a living database that provides users with a snapshot of the current state of their unit or the Corps as a whole, TFDW is used primarily for historical data. As such, TFDW data is populated by MCTFS on the last day of each month and holds records going back nearly 30 years.

4. Humanitarian Assistance Proxy

As mentioned earlier, CTS only captures deployment under OEF/OIF. Though helpful, this information does not include whether or not a Marine participated in a

humanitarian assistance operation. To collect this information, the Humanitarian Service Medal (HSM) was used as a proxy for HA/DR participation.

According to the Department of the Navy's Awards Manual, the HSM is an individual award given to members of the armed services that, "distinguish themselves by meritorious, direct, or non-routine participation in a significant military act or operation of a humanitarian nature." Award and service information within TFDW allowed for a data file to be populated that contained the EDIPI of all Marines that were awarded the HSM for actions that took place between 2001 and 2011. The data from TFDW includes the exact date the action which warranted the HSM occurred, which when cross referenced to the DOD's list of authorized humanitarian operations allows the exact operation to be identified. This file was later merged with data from DMDC and TMA to create the final analytical sample.

5. Frequency of HA/DR Deployments

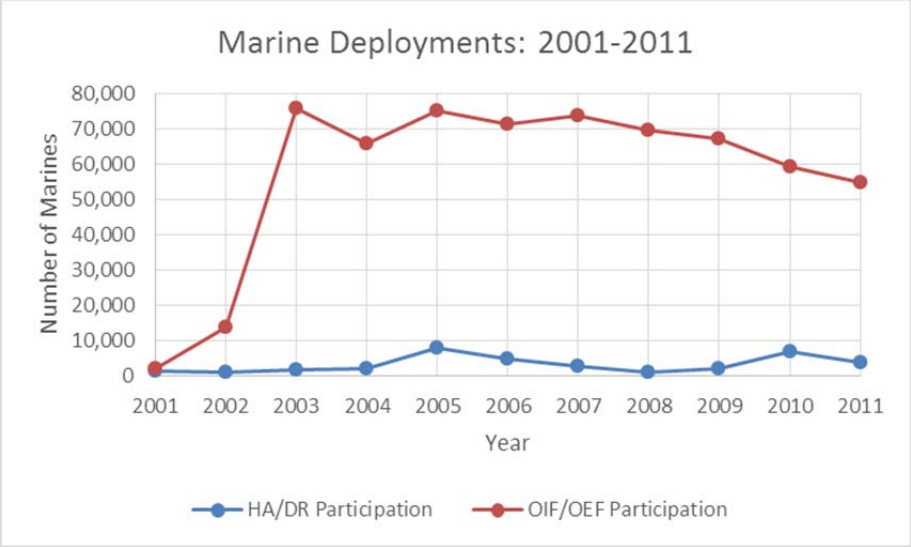
Due to the unpredictable nature of natural disasters requiring HA/DR aid, the frequency of Marines deployed in support of these operations has been relatively sporadic throughout the observation period. Figure 1 shows the frequency distribution of Marines deployed throughout the observation period, both in support of HA/DR operations as well as in support of OIF/OEF. Between 2001 and 2011, the Marine Corps averaged 3,333 Marines deployed in support of HA/DR operations per year, with an average of 57,126 deployed to OIF/OEF.

Two years observed have noteworthy deviations in the number of Marines conducting HA/DR operations; 2005 and 2010. In 2005, the Marine Corps as well as the DOD deployed in support of some of the most devastating natural disasters in recent history. Within one year, nearly 8,000 Marines deployed in support of relief efforts for Hurricanes Katrina and Rita off the Southern Coast of the United States as well as a six month relief operation in Pakistan following a devastating earthquake starting in October 2005. Similarly, in 2010, 7,000 Marines deployed in support of Operation Unified Response following the Haitian Earthquake, flooding in Pakistan after weeks of heavy

monsoon rains and disaster relief in the Philippines following Super Typhoon Juan. Each of these events left thousands dead and caused billions of dollars in damage.

The depiction of Marines deployed to OIF/OEF shown in Figure 1 also has some noteworthy milestones. First, in 2001, before the start of the Global War on Terror, nearly as many Marines deployed to HA/DR operations as combat operations. This is significant because it shows the consistency of humanitarian assistance operations both during combat operations as well as alone. Next, the rapid spike in Marines deployed from 13,764 in 2002 to 75,652 in 2003 was caused by the invasion of Iraq in March of 2003. During this operation, an entire division of Marines along with thousands of joint forces began an eight-year campaign that sent several million service members overseas. Finally, the steady decline in deployed Marines in support of OIF/OEF starting in 2008 was a result of the end of the Iraq War, with the final combat troops returning to the United States in 2011.

Figure 1. Marine deployments between 2001 and 2011



Adapted from: Analytical sample including data from DMDC, TMA and TFDW.

B. DEFINING THE ANALYTICAL SAMPLE

The data provided from DMDC, TMA and TFDW were merged to form one master working dataset. From this file, two separate analytical samples were generated,

one for enlisted personnel and one for officers (including both commissioned officers and warrant officers). Both samples contained identical outcome variables and demographic variables. They differ only in how the rank information is defined, and two additional service specific variables for the enlisted sample. In particular, the Armed Forces Qualification Test (AFQT) score and enlistment waiver information are exclusive only to enlisted Marines and were, for that reason, omitted from the officer sample. Each variable will be explained in depth in the following section of this thesis.

C. KEY VARIABLES

The models used for this thesis include a collection of different variables to measure the effect of HA/DR participation on mental health diagnosis rates. Outcome variables, deployment information, demographic variables and service variables were all included to create a model that captures as accurate an effect as possible.

1. Outcome Variables

This research will analyze four separate outcomes, whether a Marine was diagnosed with post-traumatic stress disorder, depression, substance abuse or a suicidal attempt. Each variable is defined through the DMDC and Tricare data provided and is indicated as binary, with 1 representing a positive diagnosis for each of the respective mental diseases and zero representing no diagnosis. Whereas three of the four outcome variables can be intuitively defined off of DSM-IV criteria or ICD-9 codes—post-traumatic stress disorder, depression and substance abuse—the final variable, self-inflicted injuries, requires some more clarification.

Like the other three outcome variables, self-inflicted injuries was classified through corresponding ICD-9 codes, however, there is no distinction between a suicide attempt and a completed suicide. Therefore, for the purposes of this research, the suicide attempt variable includes both attempts and completions.

2. Deployment Information

For this research, two sets of deployment variables were used to accurately capture a Marine's deployment information during the observed period. One set captures

deployment related to OEF/OIF and another set captures HA deployment. First, a binary variable was created that captured whether or not a Marine was deployed to OEF/OIF during each CY. This variable took on the value of 1 if the Marine was deployed for any amount of time during the corresponding CY and 0 if they were not. This variable included deployments not only in support of Operation Iraqi Freedom (OIF) in Iraq and Operation Enduring Freedom (OEF) in Afghanistan but to a classified and non-specified locations as well.

In order to capture the effects of an OIF/OEF deployment after a Marine has returned, a second variable was created to represent the time following deployment. In this case, the variable took on the value of 1 if a Marine had deployed in a prior year and 0 if they had not. This variable is mutually exclusive with the OIF/OEF deploy variable mentioned above, that is, only one of the two variables can hold a value of 1 for a given CY. This variable remains zero if a Marine never deploys in support of OIF/OEF during the observation period and will remain 1 the year following a deployment until the Marine either deploys again or leaves the sample.

A unique variable developed for this research determines if a Marine had participated in a Humanitarian Assistance/ Disaster Relief operation. As mentioned earlier, the awarding of a Humanitarian Service Medal (HSM) serves as a proxy for this variable. If a Marine was awarded a HSM, and therefore participated in a HA/DR operation between 2001 and 2011, the variable will take on the value of 1. Because the data covers all Marines over a 10-year period, it is possible a Marine received multiple HSMs and will therefore have the appropriate data entry for each year.

The final deployment variable generated represents a Marine who had previously participated in a HA/DR operation. Similarly to the post deployment variable, the post HA/DR variable takes on the value of 1 if a Marine took part in a HA/DR operation in a previous year, and 0 otherwise. This variable is mutually exclusive with the HA/DR variable within the same CY, but not the OIF/OEF deployment or OIF/OEF post deployment variables as it is possible for a Marine to conduct a HA/DR operation while deployed in support of the Global War on Terrorism.

3. Demographic Variables

In order to correctly capture the effect humanitarian assistance participation has on the rate of mental health diagnosis, several descriptive demographic variables were included in the model as regressors. Although no prior research has been done analyzing impacts of a humanitarian assistance mission, prior research on combat exposure has shown that specific demographic variables have a role in diagnosis, prompting several to be included.

a. Age and Gender

A variable for gender was included with a female indicator that takes on the value of 1 if a Marine is a female and 0 otherwise. The analytical sample contained a small sample of Marines who, for one reason or another, did not identify a gender. This sample consisted of 683 observations, or 0.03% of the analytical sample and were coded to be included with the majority gender. An age variable was included and identifies the age of a Marine on the last day of the CY. For ease of coefficient interpretation, further age categories were developed from the original age variable that classified Marines in one of six ranges (<22, 22–24, 25–29, 30–34, 35–39, >40). The age category of <22 comprised 32.15% of the sample and was used as the reference.

b. Race and Ethnicity

Along with gender and age, race and ethnicity were also included as a single demographic variable. A Marine's race and ethnicity was accounted for using a series of mutually exclusive binary variables that each took on the value of 1 if the Marine identified as a particular race and 0 if otherwise. Being mutually exclusive, each Marine will only appear in one category. Race indicators included were white, black, Hispanic, Asian, other minority (which included Native American or Asian Pacific Islander) or unknown race. For the model, white served as the reference group.

c. Marital Status

Family information was captured in several ways so to fully account for any difference in mental health diagnosis rates. First, variables were included to identify a

Marine's marital status. These indicator variables, married, single and divorced/separated were included as mutually exclusive binary variables that were evaluated on the last day of the CY. Because the data spanned 10 years, it was possible for a Marine to have been divorced in year 1 and re-married in year 10, therefore an additional variable was added to show if a Marine was previously divorced/separated/widowed. This variable took on a value of 1 if a Marine previously identified as being divorced/separated/widowed in a previous year and was not mutually exclusive with the original marital status variable of married. For this study, single served as the reference group.

d. Dependents

In addition to marital status, variables were included to indicate the number of dependents a Marine had. This variable characterized a Marine in one of four different groups based on the number of dependents they had on the last day of the CY. These categories, 0, 1, 2 and 3 or more were mutually exclusive within a CY but were allowed to increase or decrease over time. For this study, 0 dependents comprised 55.75% of the sample and was used as the reference group.

4. Service Variables

Service specific variables were included in the model to supplement the demographic variables previously mentioned. These variables include deployment information, military occupational specialty, rank and, for enlisted Marines only, armed forces qualification test score and enlistment waivers. Each service variable will now be discussed in detail.

a. Military Occupational Specialty

A Marine's military occupational specialty (MOS), is a four digit code that identifies a Marine's job within the service. While there are several hundred different specialties, all fall within one of the three following categories: combat arms, combat service support and aviation. Combat arms Marines are members of the infantry, artillery and armor communities. These Marines are traditionally exposed to more combat and, until recently, have been an exclusively all male service. Combat arms Marines account

for 28% of the analytical sample. Combat service support is a classification given to supporting specialties, such as logisticians, communications, engineers and military police. Combat service support Marines account for 45% of the analytical sample. The final MOS specific variable includes all Marines with aviation specialties, to include pilots, maintenance workers and aircraft crew. The aviation community accounts for 19% of the analytical sample. Combat service support was used as the reference for this research.

b. Rank

Rank was captured in this research in two different ways. First, differentiating the enlisted and officer populations within the Marine Corps with different analytical samples allowed for different service variables to be included and provide a better analysis. Second, within the two separate analytical samples, Marines were further categorized into groups based on their pay grade on the last day of the CY. Enlisted Marines were separated into five separate variables, E-1/E-2, E-3, E-4, E-5 and E-6 and above. The officer sample was separated into six separate variables, O-1/O-2, O-3, O-4, O-5, O-6 and above, and Warrant Officer. The warrant officer population was not further divided into individual ranks because the warrant officer presence within the data is so small, only .95%. Lance Corporals (E-3) make up 23.07% of the entire Marine sample and will therefore be used as the reference for the enlisted models. Similarly, Captains (O-3) make up the largest percentage of the officer sample and, as such, will be used as the reference.

5. Enlisted-Specific Service Variables

a. Armed Forces Qualification Test

The Armed Forces Qualification Test (AFQT) is a subset of the Armed Services Vocational Aptitude Battery (ASVAB), the standardized test required for military enlistment regardless of service. AFQT score serves as a proxy for individual ability in this study and is only present in the enlisted sample. AFQT scores are categorized in five categories based on the service member's overall score. The higher the score and category the more intelligent and trainable the Marine is considered to be. Each AFQT

category variable is binary with the variable taking on the value of 1 if the Marine's AFQT score falls within the respective category and 0 otherwise. All AFQT categories are mutually exclusive and do not change over time as the ASVAB is taken only on enlistment. The AFQT categories with corresponding scores are Category 1 (93–99), Category II (65–92), Category IIIA (50–64), Category IIIB (31–49) and Category IV/V (1–30). Category II comprised 33.02% of the sample and was used as the reference for the enlisted models.

b. Enlistment Waivers

The final variable included exclusively in the enlisted model involves a collection of binary variables that capture the presence and severity of waivers required for enlistment. These binary variables include waivers for a minor offense, major/ felony offense, drug offense, other or none. Nested within the minor offense category includes minor criminal offense waivers and traffic violations while the major offense category includes felonies. Other waivers include non-criminal waivers including age, medical, education and mental health waivers. This category is included solely in the enlisted sample not because officers do not require waivers, but because the frequency of officer waivers issued is negligible. Each binary variable takes on the value of 1 if the Marine required the respective waiver when they enlisted and 0 otherwise. These variables are not mutually exclusive however it is unlikely more than one category of waiver would be issued for enlistment. 68.31% of the sample required no waiver, and will therefore be used as the reference.

D. DESCRIPTIVE STATISTICS

Tables 1–3 provide descriptive statistics for the analytical sample used in this research. Five separate columns of means are provided as a snapshot of the Marines observed in each model. The first column of each table, labeled "Whole Sample" provides descriptive statistics of the 2,686,878 observations used in the model. The majority of observations were male (93.73%), white (70.49%) and enlisted (90.44%). MOS distribution has the majority of Marines serving within a combat service support field (45.48%), 28.35% in a combat arms MOS and 18.96% in an aviation specialty. Of

the 2,686,878 observations, 23.39% participated in an OIF/OEF deployment while only 1.35%, or roughly 36,000 Marines, participated in a HA/DR operation.

The following four columns of each table describe the sample of Marines diagnosed with the respective mental health condition. The sample size for those varied as follows: Depression: 29,573 observations, PTSD: 44,588 observations, Substance Abuse: 18,275 and self-inflicted injuries: 11,849 observations.

Table 1. Percent of Marines in each deployment category: whole sample and by mental health diagnoses

		Marines with Mental Health Diagnosis			
	Whole Sample	Depression	PTSD	Substance Abuse	Self-Inflicted Injuries
Deployment Information					
During Year of HA/DR Participation	1.32%	0.57%	0.54%	0.79%	0.52%
Post HA/DR Participation	3.41%	3.11%	5.66%	3.75%	1.76%
Deployed (OIF/OEF)	24.06%	14.76%	32.26%	16.11%	11.02%
Post Deployed (OIF/OEF)	17.80%	29.29%	47.40%	32.96%	16.14%
Sample size (n)	2,597,440	11,200	17,461	7,757	2,767

Table 2. Percent of Marines in demographic categories: whole sample and by mental health diagnoses

		Marines with Mental Health Diagnosis			
	Whole Sample	Depression	PTSD	Substance Abuse	Self-Inflicted Injuries
Demographic Information					
White	71.07%	73.78%	73.45%	75.93%	75.00%
Black	11.48%	10.59%	9.47%	8.35%	9.83%
Hispanic	8.61%	8.01%	9.47%	8.21%	8.45%
Asian	2.87%	2.38%	2.19%	2.22%	2.65%
Other Race	5.97%	5.24%	5.42%	5.29%	4.07%
Male	93.86%	83.46%	91.29%	93.31%	84.90%
Female	6.12%	16.54%	8.71%	6.69%	15.10%
Age Category					
<22	32.30%	29.92%	19.76%	27.15%	51.38%
22-24	26.24%	28.96%	35.81%	37.76%	26.31%
25-29	19.22%	21.82%	24.67%	22.81%	11.92%
30-34	8.98%	8.46%	9.07%	6.21%	2.62%
35-39	6.21%	5.17%	5.69%	3.18%	1.12%
>40	7.06%	5.68%	5.01%	2.89%	6.65%
Married	42.26%	49.40%	55.07%	40.62%	30.46%
Post Divorce	5.01%	7.36%	7.99%	6.14%	4.04%
Single	52.73%	43.24%	36.95%	53.24%	65.51%
Number of Dependents					
0	55.91%	48.55%	41.61%	57.75%	70.44%
1	16.51%	20.66%	22.91%	18.55%	15.58%
2	11.25%	14.00%	15.76%	11.72%	7.44%
3+	16.33%	16.79%	19.72%	11.98%	6.54%
Sample size (n)	2,597,440	11,200	17,461	7,757	2,767

Table 3. Percent of Marines in service categories: whole sample and by mental health diagnoses

		Marines with Mental Health Diagnosis			
	Whole Sample	Depression	PTSD	Substance Abuse	Self-Inflicted Injuries
Service Information					
Combat Arms MOS	28.75%	26.64%	45.22%	34.90%	28.55%
Combat Service Support MOS	46.11%	49.94%	43.45%	45.78%	40.62%
Aviation MOS	19.18%	16.77%	8.13%	15.34%	12.93%
Missing MOS	4.56%	4.38%	1.97%	3.22%	12.48%
Other MOS	2.27%	3.28%	1.66%	1.82%	6.84%
Enlisted (Total)	90.41%	96.03%	96.78%	97.98%	99.07%
E-1/E-2	19.19%	14.44%	6.84%	16.97%	37.86%
E-3	23.11%	31.48%	26.53%	37.09%	36.14%
E-4	19.08%	20.36%	26.87%	21.77%	14.39%
E-5	15.05%	17.09%	22.32%	14.41%	7.55%
E-6 & Above	13.99%	12.66%	14.21%	7.73%	3.14%
Officer (Total)	8.79%	3.37%	2.50%	1.80%	0.67%
O-1/O-2	2.44%	0.70%	0.37%	0.57%	0.30%
O-3	2.67%	1.25%	1.01%	0.52%	0.04%
O-4	1.89%	0.74%	0.64%	0.45%	0.26%
O-5	1.28%	0.48%	0.34%	0.22%	0.07%
O-6 & Above	0.51%	0.20%	0.14%	0.05%	0.00%
Warrant Officer	0.95%	0.63%	0.81%	0.21%	0.19%
AFQT Category					
I	4.44%	3.85%	2.49%	3.47%	4.00%
II	33.02%	33.13%	27.87%	33.31%	36.77%
IIIA	23.33%	25.38%	26.26%	26.90%	26.83%
IIIB	25.97%	30.00%	36.44%	31.91%	30.12%
IV/V	13.24%	7.64%	6.95%	4.41%	2.28%
Waiver- None	68.30%	73.41%	73.48%	75.97%	80.79%
Waiver- Minor	1.42%	1.24%	1.47%	1.07%	0.64%
Waiver- Major/Felony	2.46%	2.49%	2.83%	3.44%	1.76%
Waiver- Drug	3.64%	3.08%	3.87%	4.54%	4.30%
Waiver- Other	11.21%	12.67%	12.49%	11.68%	10.84%
Sample size (n)	2,597,440	11,200	17,461	7,757	2,767

E. METHODOLOGY

Understanding that each Marine in the dataset is present for a different amount of time, and has different demographic and service experiences, this thesis analyzes the relationship between deployment and mental health diagnoses using a survival analysis technique. Specifically, knowing the exact year a Marine was exposed to a Humanitarian Assistance/ Disaster Relief operation as well as the exact year a Marine was diagnosed with one of the mental health disorders examined allows the use of the standard Cox proportional hazard model (Cox, 1972; StataCorp LP, 2009). This model will estimate the relationship between mental health diagnosis of either depression, PTSD, substance

abuse or self-inflicted injuries and the risk factor of HA/DR participation while controlling for other demographic and service variables.

The data for this research observes all Marines until December of 2011, therefore it is a collection of panel data with yearly observations between 2001 and 2011. A Marine enters the model, or risk window, either when they enlist or are commissioned or at the start of the data, in this case January 1, 2001 (denoted as t_0). Each year following their first observation will be denoted as t_1, t_2, t_3, and so on. A Marine leaves the risk window when they are diagnosed with a mental health disorder. All other Marines are censored either in 2011 or when their observations stop, either because the Marine left service or has died.

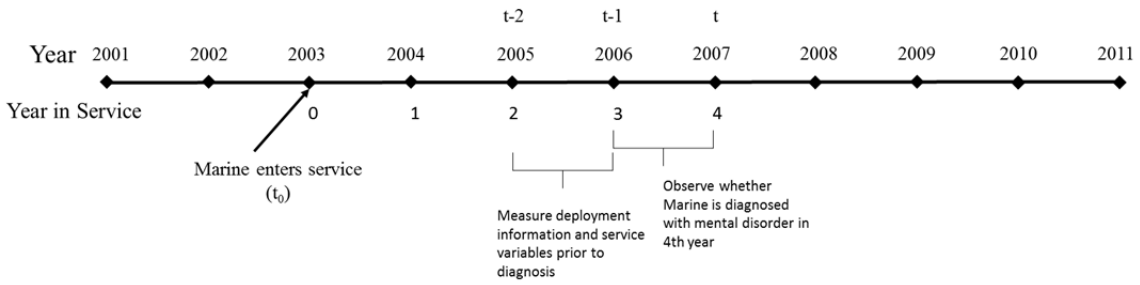
In the model, the hazard rate that Marine i was diagnosed with mental disorder j given that the Marine was not diagnosed prior to a given year is described by the following hazard function, $\lambda_i(t)$:

$$Prob(Marine\ i\ was\ diagnosed\ with\ mental\ disorder\ j\ by\ year\ t| \\ Marine\ i\ was\ not\ diagnosed\ by\ t-1) = \exp(\beta_1 DI_{it-1} + \beta'_2 X_{it} + \beta'_3 S_{it-1})\lambda_0(t)$$

where $\lambda_0(t)$ is the baseline hazard rate for a mental health diagnosis for 0–12 months before year t; DI_{it-1} is a binary deployment indicator to capture whether Marine i was deployed during year $t-1$; X_{it} is a collection of demographic variables for Marine i as of year $t-1$ and S_{it} is a collection of service variables for Marine i as of year $t-1$.

Ultimately, the model looks to determine whether participation in a Huminatarian Assistance/ Disaster Relief operation in the year before $t-1$, or in any year before $t-1$ using the post HA/DR variable, affects the probability of mental health diagnosis in the $(t-1, t)$ period, given a diagnosis did not occur up to $t-1$. Figure 2 provides a graphical depection of when measurments were taken in the model.

Figure 2. Example of the timing of measuring a mental health diagnosis and deployment information



In total, there were four models used to measure the impact of HA/DR operations on each of the four mental health diagnoses.

F. SUMMARY

Using data collected from a variety of Department of Defense sources, I implement survival analysis using the Cox proportional hazard model to analyze the relationship between deployment and mental health outcomes. The model will determine whether or not participation in a HA/DR operation has any impact on the rates of diagnosis of four major mental disorders as well as see if any significant differences exist between enlisted and officer sample. The next chapter will present the results of each model as well as examine the impacts of each variable.

IV. RESULTS

This chapter presents the multivariate results based on the Cox proportional hazard model. Section A presents and discusses baseline demographic information for the sample of Marines prior to their participation in either a HA/DR operation or an OIF/OEF deployment. Such comparison can reveal whether there is systematic differences between Marines deployed to different types of mission. Section B presents the four multivariate models, one each for depression, post-traumatic stress disorder, substance abuse and self-inflicted injuries. Section C identifies some limitations in the models and discusses additional sensitivity analysis, and Section D will provide a summary of the chapter.

A. MARINE INFORMATION PRIOR TO DEPLOYMENT

In an effort to better understand the sample of Marines that participate in either HA/DR operations or a deployment in support of OIF/OEF, I compare the demographic and service information during the years prior to each Marine's deployment. This information is presented in Tables 4 and 5. The samples were significantly different in size, with the HA/DR sample consisting of 97,221 person-year observations while the OIF/OEF sample had 619,830 observations.

Generally, the sample of Marines who will have participated in a HA/DR operation are similar to those who will deploy in support of OIF/OEF. Both samples are predominately male (HA/DR: 96.85%, OIF/OEF: 95.39%) and white (HA/DR: 73.09%, OIF/OEF: 72.90%). Marital status, though different by 10%, still shows the majority of Marines as single, with a higher percentage of single Marines deploying in support of OIF/OEF than a HA/DR operation (HA/DR: 53.73%, OIF/OEF: 64.47%).

The biggest difference demographic between the two samples of Marines was in age. Marines deployed to OEF/OIF tend to be younger compared to those deployed to HA/DR missions. More than half of those deployed in support of OIF/OEF were 22 years old or younger, while fewer than 40% were in this age category for HA/DR operations.

Table 4. Demographic information for Marines prior to deployment

		HA/DR	OIF/OEF
		Percentage	Percentage
Demographic Information			
White		73.09%	72.90%
Black		11.12%	10.70%
Hispanic		7.07%	7.12%
Asian		2.66%	2.70%
Other Race		6.05%	6.57%
Male		96.85%	95.39%
Female		3.14%	4.60%
Age Category			
	<22	39.79%	51.30%
	22-24	19.73%	19.39%
	25-29	18.77%	14.75%
	30-34	11.91%	8.02%
	35-39	6.53%	4.33%
	>40	3.28%	2.21%
Married		42.62%	32.72%
Post Divorce		3.65%	2.81%
Single		53.73%	64.47%
Number of Dependents			
	0	55.78%	66.02%
	1	14.85%	12.89%
	2	10.86%	8.63%
	3+	18.51%	12.46%
Sample size (n)		97,221	619,830

Whereas the demographic information for the two samples of Marines prior to HA/DR operations and OIF/OEF deployments are generally similar, the samples have some distinctly different background service variables. For example, HA/DR operations have a higher percentage of Marines with aviation military occupational specialties (HA/DR: 27.25%, OIF/OEF: 19.24%). Because of the distributed nature of HA/DR operations, as well as expected damage to road infrastructure following a disaster, Marine aviation is often used to meet the HA/DR commander's needs. The larger share of aviation assets is also reflected in the difference of officer presence since Marine aviators are solely officers (HA/DR: 14.51%, OIF/OEF: 9.23%). All other service variables are similar between HA/DR and OIF/OEF deployments.

Table 5. Service information for Marines prior to deployment

	HA/DR	OIF/ OEF
	Percentage	Percentage
Service Information		
Combat Arms MOS	30.02%	32.59%
Combat Service Support MOS	40.63%	46.89%
Aviation MOS	27.25%	19.24%
Missing MOS	2.02%	0.00%
Other MOS	1.17%	1.29%
Enlisted (Total)	84.82%	90.53%
E-1/E-2	21.20%	32.82%
E-3	23.02%	25.75%
E-4	12.69%	11.22%
E-5	12.70%	9.69%
E-6 & Above	15.21%	11.04%
Officer (Total)	14.51%	9.23%
O-1/O-2	5.22%	4.11%
O-3	4.41%	2.40%
O-4	2.92%	1.47%
O-5	1.43%	0.98%
O-6 & Above	0.52%	0.27%
Warrant Officer	1.16%	0.66%
AFQT Category		
I	4.74%	4.63%
II	33.01%	33.57%
IIIA	22.28%	23.18%
IIIB	23.79%	26.01%
IV/V	16.18%	12.60%
Waiver- None	66.36%	68.84%
Waiver- Minor	1.86%	1.52%
Waiver- Major/Felony	2.29%	2.45%
Waiver- Drug	2.16%	3.76%
Waiver- Other	11.05%	11.14%
Sample size (n)	97,221	619,830

B. COX PROPORTIONAL HAZARD MODELS

This section will present the results of the Cox proportional hazard models used to conduct the analysis. First, I will present the effects of both HA/DR and OIF/OEF deployments on mental health outcomes. Next, I will discuss other significant risk factors of mental health outcomes identified in the results of the models. These risk factors include a collection of demographic and service variables that had significantly higher or lower hazard ratios than the reference groups. Finally, I will introduce and present the

results of two additional explanatory models that were produced to further analyze the sample.

1. Effect of Deployments on Mental Health Outcomes

Table 6 presents the results of the four Cox proportional hazard models, specifically the hazard ratios and confidence intervals associated with the four deployment variables. The first column of Table 6 shows that HA/DR deployment is associated with lower hazard of depression relative to Marines who were never deployed to any missions. Specifically, during the year of deployment in support of a humanitarian assistance operation, the hazard of depression is 0.417 (CI 0.326, 0.534). In the years since the HA/DR operation, the hazard of depression remained low (HR 0.820; CI 0.735, 0.914). In contrast, while Marines during the year of an OEF/OIF deployment had significantly lower hazard of a depression diagnosis (HR 0.601; CI 0.566, 0.637), the risk is elevated substantially in the years following a Marine's return from an OIF/OEF deployment (HR 1.617; CI 1.532, 1.706).

The second column of Table 6 shows that Marines observed during the year of their HA/DR deployment have a lower risk of PTSD relative to those who were never deployed (HR =0.374; CI 0.306, 0.458). Their risk of PTSD becomes comparable to the reference group after they returned from the HA/DR deployment. The most significant risk factor for a Marine to develop PTSD is, not surprisingly, previous deployments in support of OIF/OEF. During the year of a Marine's OEF/OIF deployment, they are 2.98 times more likely (CI 2.835, 3.133) than those with no deployment experience to be diagnosed with PTSD. After returning from the deployment, these Marines were 6.18 times more likely to be diagnosed with PTSD relative to those who were never deployed (CI 5.873, 6.509).

Similar to the previous two outcomes, Table 6 shows that Marines who were deployed to a HA/DR mission have a lower hazard of substance abuse relative to those who never deployed during the year of their HA/DR deployment (HR 0.508; CI 0.395, 0.654) and a comparable hazard after they return from the mission. Similarly, Marines who participate in an OEF/OIF deployment have a lower hazard of substance abuse

during the year of their deployment (HR =0.628; CI 0.586, 0.673), but their risk of substance abuse increases after they return from an OIF/OEF deployment (HR 1.972; CI 1.851, 2.100).

The final model involving self-inflicted injuries, whose results are presented in the final column of Table 6, found that participation in a HA/DR operation both in the year observed and in following years had a negative effect on the rates of a Marine injuring themselves, with 0.434 (CI 0.256, 0.734) and 0.858 (CI 0.641, 1.140) hazard ratios, respectively. Participation in a deployment in support of OIF/OEF in the current year observed also had a negative impact on the rate of a self-inflicted injury with a hazard ratio of 0.511 (CI 0.447, 0.584) however, in the years following completion of an OIF/OEF deployment, a Marine is at a 50% higher risk self-injury (HR 1.501 CI 1.319, 1.708) relative to Marines who have never deployed.

Table 6. Effect of deployments on mental health outcomes

	Depression # Diagnosed = 11,200		PTSD # Diagnosed = 26,743		Substance Abuse # Diagnosed = 9,971		Self Inflicted Injuries # Diagnosed = 2,763	
	Hazard Ratio	95% CI	Hazard Ratio	95% CI	Hazard Ratio	95% CI	Hazard Ratio	95% CI
Deployment Information								
During Year of HA/DR Participation	0.417 **	[0.326 , 0.534]	0.374**	[0.306 , 0.458]	0.508**	[0.395 , 0.654]	0.434**	[0.256 , 0.734]
Post HA/DR Participation	0.819**	[0.735 , 0.914]	1.024	[0.959 , 1.093]	0.978	[0.87 , 1.1]	0.858	[0.641 , 1.14]
During Year of OIF/OEF Participation	0.601**	[0.566 , 0.637]	2.98**	[2.835 , 3.133]	0.628**	[0.586 , 0.673]	0.511**	[0.447 , 0.584]
Post OIF/OEF Participation	1.617**	[1.532 , 1.706]	6.183**	[5.873 , 6.509]	1.972**	[1.851 , 2.1]	1.501**	[1.319 , 1.708]

Notes: + p<0.1, * p<0.05, ** p<0.01. Complete survival analysis results are included in the Appendix.

2. Other Significant Risk Factors of Mental Health Outcomes

Table 9 in the Appendix presents the complete multivariate regression results of the four separate Cox proportional hazard models. Outside of the four deployment variables, I examined over 40 different demographic and service specific variables and their respective hazard ratios to better understand the risk of mental illnesses faced by Marines. This section will present selected hazard ratios for some demographic and service variables.

The strongest risk factor identified for a diagnosis of depression is being female with a hazard ratio of 2.965 (95% CI 2.81, 3.129), or a 296 percent higher hazard of

clinical depression. Having 3 or more children, being divorced, and being married were also found to be strongly associated with elevated likelihood of depression with hazard ratios of 1.424 (CI 1.306, 1.551), 1.754 (CI 1.599, 1.924), and 1.503 (CI 1.400, 1.615), respectively.

The analysis conducted on the likelihood of a diagnosis of PTSD also found that the hazard for a female Marine was significantly higher than the reference male sample, with a hazard ratio of 2.317 (CI 2.192, 2.450). The trend of seeing female Marines at a higher risk for diagnosis was seen consistently throughout all models and led to the development of a follow on interaction model to be discussed later.

Interestingly, a substance abuse diagnosis was more prevalent in older Marines, with higher risks of diagnosis seen in every age group older than the reference, with the exception of the oldest category. This increase in hazard was also shown through the officer ranks, where Marines are generally older than their enlisted counterparts. Also, those Marines who entered service with a felony waiver were at a higher risk for a substance abuse diagnosis, with a hazard ratio of 1.333 (CI 1.179, 1.508).

The most significant demographic risk factor identified for a diagnosis of self-inflicted injury is a Marine's marital status. A divorced Marine (HR 2.105 CI 1.688, 2.624) and a married Marine (HR 1.628 CI 1.402, 1.890) are significantly more likely to inflict injury on themselves than a single Marine, which served as the reference. Also, as Marines get older, they are less likely to be diagnosed with a self-inflicted injury. The hazard rates for diagnosis steadily decrease as the age categories increase.

These rates are only a snapshot of the entire model, but point to some significantly higher or lower risks of diagnosis. The full set of hazard ratios, for all four models, can be found in Table 9 of the Appendix.

3. Additional Exploratory Analysis

The results provided from the original four Cox proportional hazard models raised some additional questions that were examined through further analysis. First, an additional interaction model between the female indicator variable and the four different

deployment variables was created. This model was constructed to test whether each type of deployment, HA/DR or OIF/OEF, affect male and female Marines differently. Further, a comparable question was posed between the officer and enlisted populations. Therefore, a similar methodology was used where I created a new model interacting the officer indicator variable with the four deployment variables. I did not implement the interaction models for the self-inflicted injury diagnosis due to an insufficient sample size for the year of HA/DR operation variable for both the gender and officer models.

a. Gender Interaction Model

The results of the gender interaction model can be found in Table 7. The interaction term between the female indicator variable and the post OIF/OEF variable produces a hazard ratio of less than 1 for all three mental illnesses evaluated. Since we already established hazard ratios of greater than 1 for the same diagnoses without the interaction of the female indicator, it can be determined that the post-OIF/OEF effect is bigger for male Marines, the reference, than it is for female Marines. In addition, female Marines are at a lower hazard for PTSD while deployed in support of OIF/OEF than their male counterparts.

Table 7. Interaction model between female indicator and four deployment variables

	Depression # Diagnosed = 11,200		PTSD # Diagnosed = 17,552		Substance Abuse # Diagnosed = 8,041	
	Hazard Ratio	95% CI	Hazard Ratio	95% CI	Hazard Ratio	95% CI
Deployment Information						
During Year of HA/DR Participation	0.420**	[0.326 , 0.542]	0.371**	[0.302 , 0.456]	0.488**	[0.376 , 0.634]
Post HA/DR Participation	0.838**	[0.751 , 0.938]	1.017	[0.952 , 1.087]	0.977	[0.867 , 1.1]
During Year of OIF/OEF Participation	0.609**	[0.572 , 0.648]	3.640**	[3.447 , 3.846]	0.638**	[0.595 , 0.686]
Post OIF/OEF Participation	1.713**	[1.619, 1.812]	7.775**	[7.351 , 8.224]	2.038**	[1.911 , 2.174]
Female X Year of HA/DR	0.872	[0.316 , 2.402]	1.216	[0.446 , 3.314]	2.377+	[0.859 , 6.578]
Female X Post HA/DR Participation	0.584*	[0.347 , 0.985]	0.831	[0.556 , 1.243]	0.919	[0.452 , 1.869]
Female X During Year of OIF/OEF	1.003*	[0.838 , 1.199]	0.327**	[0.281 , 0.382]	0.833	[0.598 , 1.159]
Female X Post OIF/OEF Participation	0.621**	[0.539 , 0.717]	0.205**	[0.179 , 0.236]	0.549**	[0.43 , 0.701]

Notes: + p<0.1, * p<0.05, ** p<0.01. Complete survival analysis results are included in the Appendix.

b. Officer Interaction Model

The results for the officer interaction model can be found in Table 8. Similarly to the female interaction model, some significant results can be drawn. The interaction term between officer and post OIF/OEF deployment indicators all have low hazard ratios suggesting enlisted Marines have higher risks of mental health problems relative to Marine officers when both returned from deployments in support of OIF/OEF.

Table 8. Interaction model between officer indicator and four deployment variables

	Depression # Diagnosed = 11,200		PTSD # Diagnosed = 17,552		Substance Abuse # Diagnosed = 8,041	
	Hazard Ratio	95% CI	Hazard Ratio	95% CI	Hazard Ratio	95% CI
Deployment Information						
During Year of HA/DR Participation	0.417**	[0.324 , 0.537]	0.370**	[0.301 , 0.455]	0.503**	[0.389 , 0.65]
Post HA/DR Participation	0.825**	[0.738 , 0.923]	1.030	[0.964 , 1.101]	0.976	[0.866 , 1.1]
During Year of OIF/OEF Participation	0.600**	[0.565 , 0.637]	3.011**	[2.862 , 3.167]	0.631**	[0.589 , 0.677]
Post OIF/OEF Participation	1.634**	[1.547 , 1.726]	6.242**	[5.925 , 6.575]	2.007**	[1.884 , 2.139]
Officer X Year of HA/DR	1.020	[0.318 , 3.268]	1.343	[0.491 , 3.675]	1.543	[0.372 , 6.392]
Officer X Post HA/DR Participation	0.920	[0.586 , 1.443]	0.870	[0.618 , 1.224]	1.175	[0.634 , 2.178]
Officer X During Year of OIF/OEF	1.054	[0.773 , 1.437]	0.633**	[0.462 , 0.868]	0.779	[0.473 , 1.282]
Officer X Post OIF/OEF Participation	0.794+	[0.621 , 1.015]	0.682**	[0.514 , 0.904]	0.430**	[0.286 , 0.648]

Notes: + p<0.1, * p<0.05, ** p<0.01. Complete survival analysis results are included in the Appendix.

C. LIMITATIONS

Although this study used the most complete data available with a proven and widely accepted survival analysis methodology, there are several limitations to this study. First was the use of a Humanitarian Service Medal as a proxy for participation in a Humanitarian Assistance operation. The Marine Corps does not collect Humanitarian Assistance/ Disaster Relief deployment information for individual Marines with the same effort as it does combat deployments. The only record available that distinguishes a Marine as one who participated in a HA/DR operation and one that has not is the Humanitarian Service Medal. Although this award represents participation in a HA/DR operation it does not represent or distinguish the level or severity of a Marine's participation. As a result, there is no way to distinguish the Marine who was recovering dead bodies from a collapsed school with the Marine who was loading a helicopter with

soccer balls and food hundreds of miles away from the disaster. Without discrediting the importance or service of either Marine, one was exposed to a significant trauma while the other was not. This type of measurement error is likely to introduce downward bias on the estimated results.

Second, the results might not be generalizable to Marine experience from a different time period. For this research, I followed Marines between 2001 and 2011. During this period, the United States was conducting significantly more military operations than in the three decades prior. With Marines committed in both Operation Iraqi Freedom and Operation Enduring Freedom, the sample used for analysis was subjected to more stress and strain than a sample of Marines from another time period.

Third, another source of measurement error comes from the aggregated nature of the data. The Marines are observed on yearly basis (as opposed to a finer time unit, such as monthly). A person who was deployed in an early month of the year is more likely to be diagnosed with PTSD, for example, later in the year than a person who was deployed in the later part of the year. This measurement error also introduces downward bias in the estimation.

Fourth, the data does not capture any mental health diagnoses of Marines after they left active service. A Marine in this sample has the potential to deploy and leave service without a mental health diagnosis, only to develop one later in life. This missing data will likely bias the estimated hazard ratios towards one, and could possibly be mitigated in the future by merging the analytical sample with information from the Department of Veterans Affairs.

Lastly, like any observational study, I do not observe all possible factors that might influence a persons' hazard of being diagnosed with mental health problems (such as genetic pre-disposition, other experiences prior to joining the military).

D. SUMMARY

This chapter presented the results of the multivariate analysis. The general finding is that Marines' hazard of mental health conditions is low relative to those who were not

deployed during the time the Marines observed were deployed (either HA/DR or OEF/OIF). This is likely due to the fact that their access to health care facility is limited during deployments and clinical diagnoses of mental health conditions can only be made by licensed health care providers. However, Marines' experiences diverge between HA/DR and OEF/OIF deployments after they return from the theater. Across all four outcomes, the results are consistent that those who return from HA/DR missions have no elevated risks of mental health conditions relative to those who never deployed. On the other hand, those who returned from OEF/OIF missions have substantially higher risks of being diagnosed with all four illnesses in the post deployment years. Further analysis also revealed that male Marines are more likely to be diagnosed with mental health problems relative to female Marines when both returned from deployments to OIF/OEF; likewise, enlisted are more likely than officers to be diagnosed with a mental health disorder following return from an OIF/OEF deployment. In this chapter, I also examined the demographic and service characteristics of the samples of Marines before either a HA/DR or combat deployment and identified some differences in the two. These differences in samples, coupled with the identified shortfalls of the research, are likely the cause of the differences in diagnosis hazard rates between HA/DR deployments and OIF/OEF deployments for each of the four mental illnesses. Finally, the chapter discussed several limitations in the study that could have introduced biases in the results presented. The next chapter will provide some conclusions drawn from these results as well as recommendations to policy makers that could improve care for Marines.

V. CONCLUSION

Marines will continue to deploy around the world even after sustained combat operations in Iraq and Afghanistan come to an end. As America's expeditionary force in readiness, the Marine Corps must be prepared to respond to any mission assigned, whether that be a small contingency operation, large-scale combat operations or humanitarian assistance operations. As training continues to ensure the Corps is fully qualified to meet these needs, extra care must be taken to protect the long term mental health of individual Marines. Any degradation in mental health is also a degradation in mission readiness. In this thesis, I compare and contrast two types of deployments and whether they are associated with elevated risks of mental health problems. In particular, I examine deployments that are part of a Humanitarian Assistance/Disaster relief operation and deployments that are in support of OEF/OIF.

A. HUMANITARIAN ASSISTANCE VS. OEF/OIF DEPLOYMENTS

I found that Marines' hazard of mental health conditions are low during either type of deployments relative to those who were not deployed. While the results might seem counterintuitive at first, this is likely due to the fact that Marines' access to health care facilities is limited during deployments, and clinical diagnoses of mental health conditions can only be made by licensed health care providers. In addition, Marines are simply too busy when conducting these operations to have the self-reflection or introspective thoughts often required for the manifestation of these illnesses. Participation in an active operation, of any type, is exhaustive and fast paced. Marines taking part in a HA/DR operation are typically under some sort of time constraint that affords them only an opportunity to focus on the mission and not reflect on the disaster. This theory is supported by the fact that this research found the hazard of diagnosis increased for all four illnesses in the years following HA/DR participation. The camaraderie and peer protection effect during deployment can also contribute to the lower risks during time of deployments.

However, Marines' experiences diverge between HA/DR and OEF/OIF deployments after they return from the theater. Across all four outcomes, the results are consistent that those who return from HA/DR missions have no elevated risks of mental health conditions relative to those who never deployed. On the other hand, those who returned from OEF/OIF missions have substantially higher risks of being diagnosed with all four illnesses in the post-deployment years.

The differences in the post-deployment experiences between these two types of deployment can be due to several possibilities. First, is the differences in the two samples. Although both were generally similar in demographic information, dissimilarities existed in both size and service information.

Second, the differences might be due to some of the study limitations discussed in Chapter IV. Shortfalls in data, availability of providers capable of diagnosing a mental disorder and inability to observe all possible mental health risk factors could all lead to the differences identified.

Third, Marines who are subjected to the horrific destruction associated with a HA/DR operation possibly become more grateful for what they have at home and lead a mentally healthier lifestyle. This idea, traditionally known as resilience or more recently known as post-traumatic growth, suggests that a positive psychological change can occur following a difficult, stressful, and potentially traumatic life event (Calhoun & Tedeschi, 2006). Marines can start relating better with others, look for new healthy opportunities, and become more connected spiritually. Research for post-traumatic growth is still in its infancy, but some applications can be applied to explain the results of this research.

Lastly, the diverging results between the two types of deployment could be partly due to the different natures of the deployment. Marines deployed to either a HA/DR operation or an OIF/OEF operation can be subjected to trauma. However, the nature of the trauma and the method by which it is inflicted vary drastically between combat and humanitarian assistance. When deployed as a humanitarian, Marines are in place to help devastated communities and assist local populations in getting through the traumatic event. However, in combat, a Marine is primarily exposed to and may potentially be the

means behind traumatic events for others—whether intentionally or not. Further comparisons between the outcomes of these two types of deployments, with the addition of many others, should be considered.

B. RECOMMENDATIONS FOR FUTURE RESEARCH

Research into the effects of combat on the mental health of Marines has been widely studied over the last 15 years; however, research into the effects different deployment types have on the mental health of Marines is extremely limited. As sustained combat in Operation Iraqi Freedom and Operation Enduring Freedom end, research into HA/DR participation should be readdressed. Without the stress of two ongoing combat operations on the shoulders of Marines, the effects of HA/DR participation could differ.

Another facet of HA/DR operations not included in this study involves the application of medical aid to disaster victims. Because the Marine Corps has no organic medical capabilities, this role is filled by Navy Corpsman and doctors. These sailors have some of the most extreme exposure to trauma during HA/DR operations, and have the potential to form bonds with their patients as their care can take days or weeks. Research into the follow-on mental health issues faced by Navy medical personnel following HA/DR operations could yield interesting results and help improve mental health policies.

This thesis studied the effects of HA/DR deployments on the mental health diagnosis rates of Marines. It was limited in scope to include only Marines and only during a 10-year period. Therefore, it is recommended that it be expanded both in size to include other military branches and in duration to include periods of time when two large scale combat operations are not underway.

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APPENDIX. RESULTS

Table 9. Effect of deployments on mental health outcomes, full results

		Depression # Diagnosed = 11,200		PTSD # Diagnosed = 26,743		Substance Abuse # Diagnosed = 9,971		Self Inflicted Injuries # Diagnosed = 2,763	
		Hazard Ratio	95% CI	Hazard Ratio	95% CI	Hazard Ratio	95% CI	Hazard Ratio	95% CI
Deployment Information									
During Year of HA/DR Participation		0.417 **	[0.326 , 0.534]	0.374**	[0.306 , 0.458]	0.508**	[0.395 , 0.654]	0.434**	[0.256 , 0.734]
Post HA/DR Participation		0.819**	[0.735 , 0.914]	1.024	[0.959 , 1.093]	0.978	[0.87 , 1.1]	0.858	[0.641 , 1.14]
During Year of OIF/OEF Participation		0.601**	[0.566 , 0.637]	2.98**	[2.835 , 3.133]	0.628**	[0.586 , 0.673]	0.511**	[0.447 , 0.584]
Post OIF/OEF Participation		1.617**	[1.532 , 1.706]	6.183**	[5.873 , 6.509]	1.972**	[1.851 , 2.1]	1.501**	[1.319 , 1.708]
Demographic Information									
White		1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Black		0.808**	[0.758 , 0.86]	0.778**	[0.738 , 0.82]	0.742**	[0.684 , 0.805]	0.961	[0.844 , 1.094]
Hispanic		0.718**	[0.669 , 0.77]	0.752**	[0.714 , 0.792]	0.732**	[0.675 , 0.794]	0.873*	[0.763 , 0.999]
Asian		0.737**	[0.652 , 0.832]	0.704**	[0.636 , 0.78]	0.668**	[0.575 , 0.775]	0.809+	[0.639 , 1.02]
Other Race		0.868**	[0.797 , 0.945]	0.939+	[0.878 , 1.004]	1.138*	[1.03 , 1.258]	1.152	[0.95 , 1.397]
Male		1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Female		2.965**	[2.81 , 3.129]	2.317**	[2.192 , 2.45]	1.117*	[1.021 , 1.222]	2.500**	[2.242 , 2.78]
Age Category									
	<22	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
	22-24	1.079**	[1.021 , 1.14]	1.233**	[1.176 , 1.292]	1.896**	[1.781 , 2.019]	0.925	[0.835 , 1.024]
	25-29	1.137**	[1.064 , 1.215]	1.147**	[1.084 , 1.213]	2.063**	[1.911 , 2.228]	0.783**	[0.678 , 0.905]
	30-34	1.128*	[1.024 , 1.242]	1.145**	[1.059 , 1.237]	1.940**	[1.714 , 2.195]	0.626**	[0.472 , 0.83]
	35-39	1.089	[0.966 , 1.228]	1.229**	[1.117 , 1.352]	1.735**	[1.465 , 2.056]	0.544**	[0.357 , 0.829]
	>40	0.715**	[0.644 , 0.794]	0.996	[0.904 , 1.097]	0.559**	[0.481 , 0.648]	0.369**	[0.311 , 0.439]
Single		1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Married		1.503**	[1.4 , 1.615]	1.405**	[1.322 , 1.493]	1.290	[1.18 , 1.411]	1.628**	[1.402 , 1.89]
Post Divorce		1.754**	[1.599 , 1.924]	1.589**	[1.475 , 1.711]	1.596	[1.423 , 1.79]	2.105**	[1.688 , 2.624]
Number of Dependents									
	0	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
	1	1.161**	[1.08 , 1.249]	1.157**	[1.088 , 1.23]	0.867**	[0.79 , 0.95]	0.898	[0.767 , 1.05]
	2	1.274**	[1.174 , 1.383]	1.221**	[1.142 , 1.306]	0.897*	[0.809 , 0.995]	0.824*	[0.68 , 0.998]
	3+	1.424**	[1.306 , 1.551]	1.407**	[1.313 , 1.509]	0.967+	[0.866 , 1.079]	1.065	[0.859 , 1.318]
Service Information									
Combat Arms MOS		1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Combat Service Support MOS		1.022	[0.976 , 1.071]	0.671**	[0.649 , 0.694]	0.929**	[0.882 , 0.978]	0.879**	[0.798 , 0.968]
Aviation MOS		0.922**	[0.87 , 0.978]	0.357**	[0.337 , 0.379]	0.835**	[0.779 , 0.894]	0.806**	[0.71 , 0.916]
Missing MOS		1.036	[0.937 , 1.147]	0.76**	[0.676 , 0.854]	0.718**	[0.628 , 0.821]	2.407**	[2.095 , 2.764]
Other MOS		2.071**	[1.841 , 2.33]	0.989	[0.872 , 1.12]	1.190+	[0.996 , 1.422]	3.433**	[2.875 , 4.099]
Enlisted (Total)		1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
	E-3	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
	E-1/E-2	0.176**	[0.165 , 0.188]	0.228**	[0.212 , 0.245]	0.256**	[0.238 , 0.275]	0.372**	[0.336 , 0.413]
	E-4	0.669**	[0.632 , 0.708]	0.776**	[0.743 , 0.811]	0.491**	[0.461 , 0.523]	0.465**	[0.41 , 0.527]
	E-5	0.507**	[0.473 , 0.543]	0.604**	[0.573 , 0.636]	0.299**	[0.276 , 0.324]	0.264**	[0.222 , 0.314]
	E-6 & Above	0.385**	[0.351 , 0.423]	0.397**	[0.369 , 0.428]	0.200**	[0.177 , 0.226]	0.162**	[0.122 , 0.217]
Officer (Total)		0.232**	[0.192 , 0.281]	0.165**	[0.14 , 0.195]	0.066**	[0.047 , 0.092]	0.027**	[0.007 , 0.112]
	O-3	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
	O-1/O-2	0.613**	[0.463 , 0.813]	0.684+	[0.513 , 0.912]	1.252	[0.816 , 1.921]	3.198	[0.673 , 15.18]
	O-4	0.813	[0.617 , 1.071]	0.792+	[0.624 , 1.004]	1.533+	[0.976 , 2.406]	6.155*	[1.268 , 29.89]
	O-5	0.874	[0.633 , 1.206]	0.655**	[0.486 , 0.884]	1.783*	[1.004 , 3.165]	3.320	[0.463 , 23.82]
	O-6 & Above	0.769	[0.485 , 1.219]	0.627*	[0.412 , 0.954]	1.711	[0.668 , 4.381]	-	-
	Warrant Officer	0.333**	[0.26 , 0.428]	0.38**	[0.318 , 0.455]	0.126**	[0.079 , 0.2]	0.206**	[0.083 , 0.514]
AFQT Category									
	<30	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
	31-49	1.163**	[1.056 , 1.28]	1.13**	[1.045 , 1.221]	1.098	[0.965 , 1.249]	1.909**	[1.43 , 2.54]
	50-64	1.077	[0.978 , 1.186]	0.984	[0.91 , 1.065]	1.052	[0.924 , 1.198]	1.894**	[1.419 , 2.528]
	65-92	1.015	[0.924 , 1.116]	0.776**	[0.718 , 0.839]	0.904	[0.795 , 1.028]	1.899**	[1.426 , 2.527]
	>93	0.883+	[0.776 , 1.005]	0.534**	[0.474 , 0.601]	0.638**	[0.538 , 0.757]	1.525*	[1.089 , 2.134]
Waiver- None		1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Waiver- Minor		1.004	[0.848 , 1.19]	1.126+	[0.995 , 1.276]	0.916	[0.739 , 1.135]	0.769	[0.482 , 1.227]
Waiver- Major/Felony		1.063	[0.942 , 1.199]	1.078	[0.984 , 1.18]	1.333**	[1.179 , 1.508]	0.789	[0.589 , 1.05]
Waiver- Drug		0.801**	[0.718 , 0.893]	0.91*	[0.841 , 0.984]	0.944	[0.848 , 1.051]	0.930	[0.772 , 1.119]
Waiver- Other		1.073*	[1.014 , 1.136]	1.094	[1.045 , 1.145]	1.041	[0.972 , 1.116]	1.025	[0.907 , 1.15]
Number of Observations (N)					2,685,661				

Notes: + p<0.1, * p<0.05, ** p<0.01

Table 10. Interaction model between female indicator and four deployment variables

	Depression # Diagnosed = 11,200		PTSD # Diagnosed = 17,552		Substance Abuse # Diagnosed = 8,041	
	Hazard Ratio	95% CI	Hazard Ratio	95% CI	Hazard Ratio	95% CI
Deployment Information						
During Year of HA/DR Participation	0.420**	[0.326 , 0.542]	0.371**	[0.302 , 0.456]	0.488**	[0.376 , 0.634]
Post HA/DR Participation	0.838**	[0.751 , 0.938]	1.017	[0.952 , 1.087]	0.977	[0.867 , 1.1]
During Year of OIF/OEF Participation	0.609**	[0.572 , 0.648]	3.640**	[3.447 , 3.846]	0.638**	[0.595 , 0.686]
Post OIF/OEF Participation	1.713**	[1.619, 1.812]	7.775**	[7.351 , 8.224]	2.038**	[1.911 , 2.174]
Female X Year of HA/DR	0.872	[0.316 , 2.402]	1.216	[0.446 , 3.314]	2.377+	[0.859 , 6.578]
Female X Post HA/DR Participation	0.584*	[0.347 , 0.985]	0.831	[0.556 , 1.243]	0.919	[0.452 , 1.869]
Female X During Year of OIF/OEF	1.003*	[0.838 , 1.199]	0.327**	[0.281 , 0.382]	0.833	[0.598 , 1.159]
Female X Post OIF/OEF Participation	0.621**	[0.539 , 0.717]	0.205**	[0.179 , 0.236]	0.549**	[0.43 , 0.701]
Demographic Information						
White	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Black	0.808**	[0.76 , 0.861]	0.779**	[0.739 , 0.821]	0.742**	[0.684 , 0.805]
Hispanic	0.719**	[0.671 , 0.772]	0.756**	[0.719 , 0.797]	0.734**	[0.676 , 0.795]
Asian	0.738**	[0.653 , 0.834]	0.708**	[0.64 , 0.784]	0.669**	[0.576 , 0.776]
Other Race	0.872**	[0.801 , 0.95]	0.953	[0.892 , 1.019]	1.142**	[1.033 , 1.263]
Male	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Female	3.244**	[3.05 , 3.449]	4.769**	[4.43 , 5.135]	1.266**	[1.143 , 1.402]
Age Category						
<22	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
22-24	1.079**	[1.022 , 1.141]	1.225**	[1.169 , 1.284]	1.895**	[1.78 , 2.017]
25-29	1.137**	[1.064 , 1.216]	1.138**	[1.077 , 1.205]	2.062**	[1.909 , 2.226]
30-34	1.125*	[1.022 , 1.24]	1.130**	[1.046 , 1.222]	1.936**	[1.711 , 2.19]
35-39	1.085	[0.962 , 1.223]	1.208**	[1.098 , 1.329]	1.729**	[1.459 , 2.049]
>40	0.711**	[0.64 , 0.79]	0.972	[0.883 , 1.072]	0.557**	[0.48 , 0.646]
Single	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Married	1.504**	[1.401 , 1.615]	1.415**	[1.332 , 1.505]	1.293**	[1.182 , 1.414]
Post Divorce	1.778**	[1.621 , 1.952]	1.645**	[1.528 , 1.772]	1.615**	[1.44 , 1.811]
Number of Dependents						
0	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
1	1.158**	[1.078 , 1.246]	1.136**	[1.071 , 1.211]	0.864**	[0.788 , 0.947]
2	1.265**	[1.166 , 1.374]	1.191**	[1.113 , 1.274]	0.892*	[0.804 , 0.989]
3+	1.402**	[1.286 , 1.528]	1.354**	[1.263 , 1.452]	0.956	[0.856 , 1.067]
Service Information						
Combat Arms MOS	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Combat Service Support MOS	1.026	[0.98 , 1.076]	0.680**	[0.658 , 0.704]	0.931**	[0.885 , 0.98]
Aviation MOS	0.926*	[0.873 , 0.983]	0.363**	[0.343 , 0.385]	0.837**	[0.782 , 0.897]
Missing MOS	1.042	[0.941 , 1.153]	0.763**	[0.679 , 0.859]	0.721**	[0.63 , 0.824]
Other MOS	2.090**	[1.858 , 2.352]	1.018	[0.898 , 1.154]	1.197*	[1.001 , 1.43]
Enlisted (Total)	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
E-3	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
E-1/E-2	0.176**	[0.165 , 0.188]	0.237**	[0.22 , 0.255]	0.257**	[0.239 , 0.276]
E-4	0.668**	[0.632 , 0.708]	0.778**	[0.745 , 0.813]	0.491**	[0.461 , 0.524]
E-5	0.508**	[0.475 , 0.544]	0.609**	[0.579 , 0.642]	0.300**	[0.277 , 0.325]
E-6 & Above	0.387**	[0.353 , 0.425]	0.404**	[0.375 , 0.435]	0.201**	[0.178 , 0.227]
Officer (Total)	0.236**	[0.195 , 0.286]	0.171**	[0.145 , 0.202]	0.067**	[0.048 , 0.093]
O-3	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
O-1/O-2	0.602**	[0.455 , 0.799]	0.667**	[0.5 , 0.89]	1.252	[0.816 , 1.921]
O-4	0.806	[0.612 , 1.063]	0.781*	[0.616 , 0.991]	1.524+	[0.971 , 2.392]
O-5	0.862	[0.625 , 1.189]	0.643**	[0.477 , 0.869]	1.763+	[0.993 , 3.129]
O-6 & Above	0.755	[0.476 , 1.197]	0.608*	[0.4 , 0.926]	1.688	[0.659 , 4.324]
Warrant Officer	0.335**	[0.262 , 0.431]	0.389**	[0.325 , 0.466]	0.127	[0.079 , 0.201]
AFQT Category						
<30	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
31-49	1.159**	[1.053 , 1.277]	1.119**	[1.035 , 1.209]	1.097	[0.964 , 1.248]
50-64	1.076	[0.977 , 1.184]	0.977	[0.904 , 1.058]	1.052	[0.924 , 1.198]
65-92	1.014	[0.923 , 1.114]	0.771**	[0.713 , 0.833]	0.903	[0.795 , 1.027]
>93	0.882+	[0.776 , 1.004]	0.532**	[0.472 , 0.599]	0.639**	[0.539 , 0.757]
Waiver- None	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Waiver- Minor	1.003	[0.847 , 1.188]	1.125+	[0.994 , 1.275]	0.916	[0.739 , 1.135]
Waiver- Major/Felony	1.063	[0.942 , 1.199]	1.077	[0.984 , 1.179]	1.333**	[1.179 , 1.508]
Waiver- Drug	0.801**	[0.719 , 0.893]	0.909*	[0.841 , 0.984]	0.944	[0.848 , 1.051]
Waiver- Other	1.073*	[1.014 , 1.137]	1.097	[1.048 , 1.148]	1.042	[0.972 , 1.117]
Number of Observations (N)			2,685,661			

Notes: + p<0.1, * p<0.05, ** p<0.01

Table 11. Interaction model between officer indicator and four deployment variables

	Depression # Diagnosed = 11,200		PTSD # Diagnosed = 17,552		Substance Abuse # Diagnosed = 8,041	
	Hazard Ratio	95% CI	Hazard Ratio	95% CI	Hazard Ratio	95% CI
Deployment Information						
During Year of HA/DR Participation	0.417**	[0.324 , 0.537]	0.370**	[0.301 , 0.455]	0.503**	[0.389 , 0.65]
Post HA/DR Participation	0.825**	[0.738 , 0.923]	1.030	[0.964 , 1.101]	0.976	[0.866 , 1.1]
During Year of OIF/OEF Participation	0.600**	[0.565 , 0.637]	3.011**	[2.862 , 3.167]	0.631**	[0.589 , 0.677]
Post OIF/OEF Participation	1.634**	[1.547 , 1.726]	6.242**	[5.925 , 6.575]	2.007**	[1.884 , 2.139]
Officer X Year of HA/DR	1.020	[0.318 , 3.268]	1.343	[0.491 , 3.675]	1.543	[0.372 , 6.392]
Officer X Post HA/DR Participation	0.920	[0.586 , 1.443]	0.870	[0.618 , 1.224]	1.175	[0.634 , 2.178]
Officer X During Year of OIF/OEF	1.054	[0.773 , 1.437]	0.633**	[0.462 , 0.868]	0.779	[0.473 , 1.282]
Officer X Post OIF/OEF Participation	0.794+	[0.621 , 1.015]	0.682**	[0.514 , 0.904]	0.430**	[0.286 , 0.648]
Demographic Information						
White	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Black	0.808**	[0.759 , 0.861]	0.778**	[0.738 , 0.82]	0.742**	[0.684 , 0.805]
Hispanic	0.718**	[0.669 , 0.769]	0.752**	[0.714 , 0.792]	0.732**	[0.675 , 0.794]
Asian	0.737**	[0.652 , 0.833]	0.704**	[0.636 , 0.78]	0.668**	[0.576 , 0.776]
Other Race	0.868**	[0.798 , 0.946]	0.939+	[0.878 , 1.004]	1.139*	[1.03 , 1.259]
Male	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Female	2.967**	[2.812 , 3.131]	2.319**	[2.193 , 2.452]	1.118*	[1.023 , 1.223]
Age Category						
<22	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
22-24	1.077**	[1.019 , 1.138]	1.231**	[1.174 , 1.29]	1.888**	[1.773 , 2.01]
25-29	1.135**	[1.062 , 1.213]	1.146**	[1.084 , 1.213]	2.057**	[1.905 , 2.221]
30-34	1.128*	[1.024 , 1.242]	1.146**	[1.06 , 1.239]	1.942**	[1.716 , 2.197]
35-39	1.091	[0.968 , 1.23]	1.232**	[1.12 , 1.355]	1.748**	[1.475 , 2.071]
>40	0.717**	[0.645 , 0.796]	0.999	[0.907 , 1.1]	0.562**	[0.484 , 0.652]
Single	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Married	1.503**	[1.4 , 1.614]	1.405**	[1.322 , 1.493]	1.291**	[1.18 , 1.411]
Post Divorce	1.754**	[1.598 , 1.924]	1.589**	[1.476 , 1.711]	1.596**	[1.424 , 1.79]
Number of Dependents						
0	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
1	1.161**	[1.08 , 1.249]	1.157**	[1.088 , 1.229]	0.866**	[0.79 , 0.95]
2	1.275**	[1.174 , 1.383]	1.222**	[1.142 , 1.307]	0.898*	[0.809 , 0.996]
3+	1.424**	[1.307 , 1.552]	1.408**	[1.313 , 1.509]	0.968	[0.867 , 1.08]
Service Information						
Combat Arms MOS	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Combat Service Support MOS	1.023	[0.976 , 1.072]	0.672**	[0.65 , 0.695]	0.930**	[0.883 , 0.979]
Aviation MOS	0.923**	[0.87 , 0.979]	0.358**	[0.338 , 0.379]	0.835**	[0.779 , 0.894]
Missing MOS	1.037	[0.937 , 1.147]	0.760**	[0.676 , 0.854]	0.719**	[0.628 , 0.822]
Other MOS	2.068**	[1.838 , 2.326]	0.986	[0.87 , 1.117]	1.185+	[0.992 , 1.416]
Enlisted (Total)	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
E-3	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
E-1/E-2	0.176**	[0.165 , 0.188]	0.229**	[0.213 , 0.247]	0.256**	[0.238 , 0.276]
E-4	0.667**	[0.63 , 0.706]	0.775**	[0.741 , 0.809]	0.489**	[0.458 , 0.521]
E-5	0.504**	[0.471 , 0.54]	0.602**	[0.571 , 0.634]	0.296**	[0.273 , 0.321]
E-6 & Above	0.383**	[0.349 , 0.42]	0.395**	[0.367 , 0.425]	0.197**	[0.174 , 0.223]
Officer (Total)	0.262**	[0.205 , 0.334]	0.240**	[0.179 , 0.323]	0.110**	[0.072 , 0.166]
O-3	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
O-1/O-2	0.556**	[0.412 , 0.751]	0.598**	[0.439 , 0.816]	0.858	[0.539 , 1.367]
O-4	0.816	[0.619 , 1.076]	0.790+	[0.622 , 1.001]	1.563+	[0.995 , 2.454]
O-5	0.853	[0.617 , 1.179]	0.632**	[0.468 , 0.854]	1.609	[0.903 , 2.866]
O-6 & Above	0.755	[0.476 , 1.198]	0.617*	[0.405 , 0.939]	1.663	[0.649 , 4.263]
Warrant Officer	0.331**	[0.258 , 0.425]	0.378**	[0.316 , 0.453]	0.124**	[0.078 , 0.198]
AFQT Category						
<30	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
31-49	1.164**	[1.057 , 1.282]	1.131**	[1.046 , 1.223]	1.106	[0.971 , 1.26]
50-64	1.079	[0.98 , 1.189]	0.986	[0.911 , 1.067]	1.061	[0.931 , 1.21]
65-92	1.018	[0.926 , 1.119]	0.778**	[0.719 , 0.841]	0.913	[0.802 , 1.039]
>93	0.886+	[0.778 , 1.008]	0.535**	[0.475 , 0.602]	0.645**	[0.544 , 0.766]
Waiver- None	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]	1.000	[1.000, 1.000]
Waiver- Minor	1.005	[0.848 , 1.191]	1.127+	[0.995 , 1.276]	0.917	[0.739 , 1.136]
Waiver- Major/Felony	1.063	[0.943 , 1.199]	1.078	[0.984 , 1.18]	1.333**	[1.179 , 1.508]
Waiver- Drug	0.801**	[0.718 , 0.893]	0.909*	[0.841 , 0.983]	0.944	[0.847 , 1.051]
Waiver- Other	1.073*	[1.014 , 1.136]	1.094**	[1.045 , 1.145]	1.042	[0.972 , 1.116]
Number of Observations (N)	2,685,661					

Notes: + p<0.1, * p<0.05, ** p<0.01

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